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A recently extinct new genus and species of freshwater mussel from Sichuan, China (Bivalvia: Unionida)

Zhong-Guang CHEN[1,5#*], Yu-Ting DAI[2#], Xin LIU[3], Yu-Xin GE[4] & Xiao-Ping WU[1,6*]

[1]School of Life Sciences, Nanchang University, Nanchang 330031, Jiangxi, China

[2]College of Animal Science and Technology, Jiangxi Agricultural University, Nanchang 330045, Jiangxi, China;
https://orcid.org/0009-0001-5856-3987; yutingdai@hotmail.com

[3]Department of Biochemistry, McGill University, Montréal, Québec H3T 1E2, Canada;
https://orcid.org/0009-0003-1494-9540; frankielx89@gmail.com

[4]Maryland Institute College of Art, Baltimore, Maryland, 21217, USA;
https://orcid.org/0009-0003-5070-7119; 1589823581@qq.com

[5]https://orcid.org/0000-0003-2689-3321; zgchen1002@foxmail.com

[6]https://orcid.org/0000-0002-8037-5640; xpwu@ncu.edu.cn

[#]These authors contributed equally to this work

[*]Corresponding authors

Abstract: A recently extinct new genus and species of freshwater mussel, *Gigaunio sichuanensis* Z.-G. Chen, Y.-T. Dai, X. Liu & X.-P. Wu **gen. & sp. nov.**, is described from the Minjiang River in Sichuan, China. The species was last recorded alive in 1964 and is now considered fully extinct, with even fresh empty shells no longer being found. The discovery increases the diversity of freshwater mussels in the upper Changjiang River and indicates the urgency of taking protective measures for freshwater mussels in the region.

Keywords: biodiversity, conservation biology, extinct species, molluscs, taxonomy

中国四川一近期灭绝的河蚌新属种（双壳纲：蚌科）

陈重光 [1#*]，代雨婷 [2#]，刘欣 [3]，葛雨馨 [4] & 吴小平 [1*]

[1] 南昌大学生命科学学院，南昌 330031，江西，中国

[2] 动物科学技术学院，江西农业大学，南昌 330045，江西，中国

[3] 生物化学学院，麦吉尔大学，蒙特利尔，H3T 1E2，魁北克，加拿大

[4] 马里兰艺术学院，巴尔的摩，马里兰 21217，美国

[#]共同第一作者

[*]通讯作者

摘要： 一个近期灭绝的河蚌新属种：四川巨蚌 *Gigaunio sichuanensis* Z.-G. Chen, Y.-T. Dai, X. Liu & X.-P. Wu **gen. & sp. nov.**，被描述于中国四川的岷江流域。该物种最后的活体记录于 1964 年，现已完全灭绝，甚至连新鲜的空壳也已无从找到。其发现丰富了长江上游河蚌的多样性，同时也突显了在这一地区对河蚌采取保护措施的紧迫性。

关键词： 生物多样性，保护生物学，灭绝物种，贝类，分类学

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Introduction

The Changjiang River basin (Yangtze) in China represents a global hotspot for freshwater mussel diversity, harboring approximately 70 recognized species, with new taxa continuing to be discovered (He & Zhuang 2013; Guo 2022; Chen *et al.* 2023; Dai *et al.* 2024ab, 2025). Despite this richness, the conservation outlook for the region's freshwater mussels is concerning, with over 50% of species considered threatened (Wu *et al.* 2000; Shu *et al.* 2009; Liu *et al.* 2019). Research on freshwater mussels within the basin has historically focused on its middle and lower reaches, leaving the upper reaches notably understudied. Recent discoveries of new freshwater mussel species even within the highly urbanized environment of Chengdu—the most populous city in the upper Changjiang River—underscore significant gaps in our current knowledge (Guo 2022; Wu *et al.* 2022). The freshwater mussel diversity in this basin remains substantially underexplored.

During field surveys conducted between 2021 and 2024, we collected a series of freshwater mussel specimens with distinctive shell morphology from the Minjiang River basin, a major tributary of the Changjiang River. In this study, we describe these specimens as a new genus and species.

Material and methods

Specimens were collected by hand from the tributaries of the Minjiang River in 2021–2024. The specimens were cleaned in water, dried, and stored at room temperature. Photographs were taken by Sony Alpha7CII and edited in Adobe Photoshop CC 2015 (Adobe, San Jose, USA). Maps were made in ArcGIS Pro (Esri, Redlands, USA). Measurements were taken point-to-point with digital calipers recorded to the nearest 0.1mm. Abbreviations. NCUXPWU: Laboratory of Xiao-Ping Wu, Nanchang University (Nanchang, China); IZCAS: Institute of Zoology, Chinese Academy of Sciences (Beijing, China); ZGCC: Collection of Zhong-Guang Chen (Chengdu, China).

Taxonomy

Family Unionidae Rafinesque, 1820
Subfamily Unioninae Rafinesque, 1820
Tribe Unionini Rafinesque, 1820
Gigaunio Z.-G. Chen, Y.-T. Dai, X. Liu & X.-P. Wu, gen. nov.

https://zoobank.org/45C07F66-E814-4DB4-BDB6-773B9FC64D85

Figs 1–4

Type species: *Gigaunio sichuanensis* Z.-G. Chen, Y.-T. Dai, X. Liu & X.-P. Wu, **sp. nov.**

Diagnosis: Shell large, symmetric, inflated, solid, thick, sub-glossy, triangular-ovate, dark gray to dark brown, without color rays. Zigzag sculpture present in umbo area. Lateral teeth of both valves reduced, weak and short.

Description: Shell large, symmetric, inflated, solid, thick, sub-glossy, triangular-ovate. Anterior margin oval, inflated; dorsal margin curved downwards; ventral margin rounded; posterior margin obliquely arc-shaped. Umbo inflated, above hinge line, located at 1/3 to 1/4 of the dorsal margin, and often eroded. Periostracum dark gray to dark brown, with thin growth lines but without color rays. Growth lines arranged in irregular concentric circles. Umbo cavity deep. Zigzag sculpture presented in umbo area and usually wear down in adults. Hinge long and strong. Without mantle attachment scars. Anterior adductor muscle scars oval, deep and smooth; posterior adductor muscle scars oval, smooth. Left valve with two strong pseudocardinal teeth, equal height; right valve with two pseudocardinal teeth, anterior one strong and high, posterior one reduced, connected to lateral teeth. Lateral teeth of both valves reduced, weak and short. Nacre white.

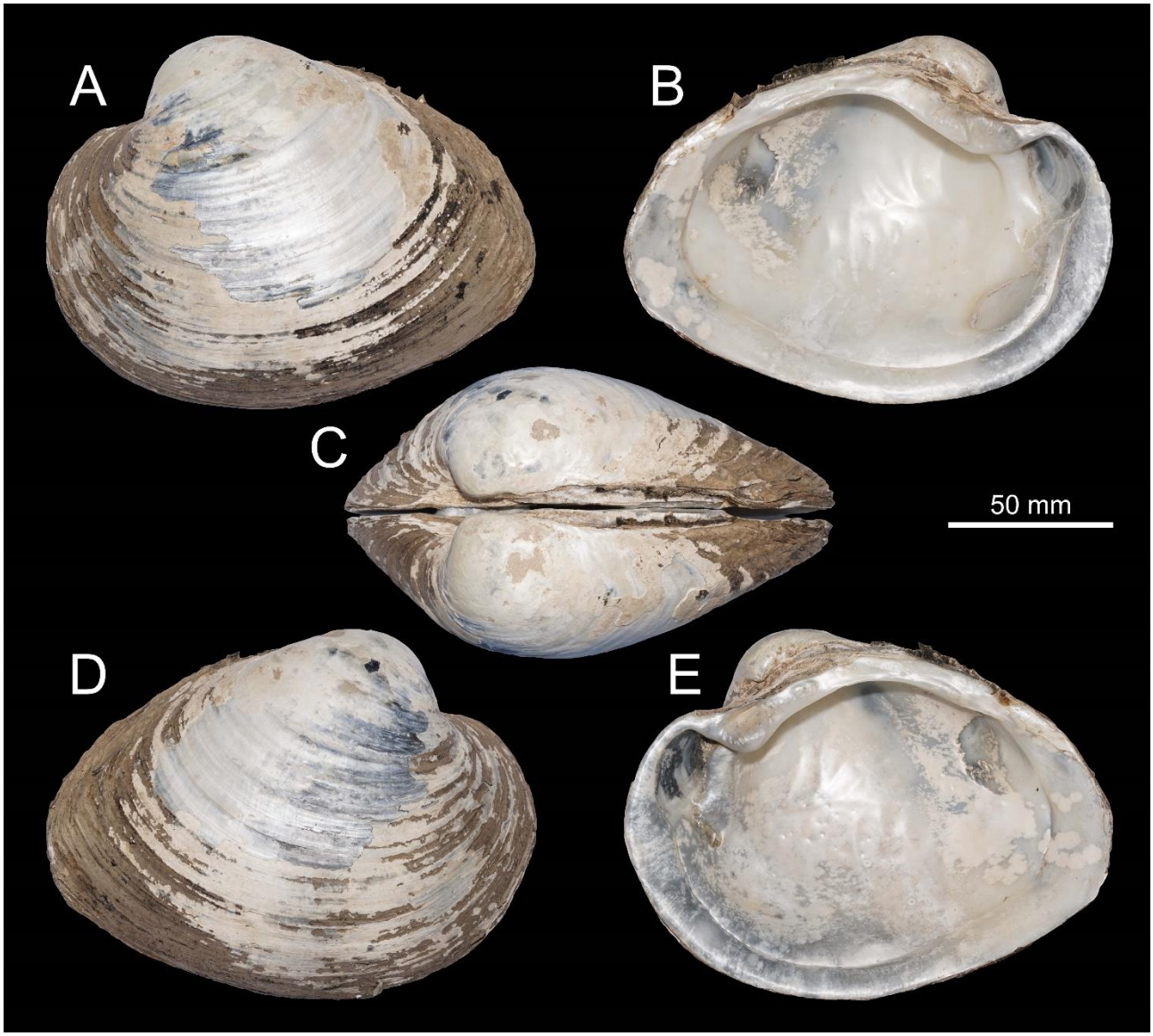

FIGURE 1. Holotype of *Gigaunio sichuanensis* **gen. & sp. nov.**, NCUXPWU 2412001.

Etymology: The genus name *Gigaunio* is made from the Latin *Gigas* for giant and the freshwater mussel genus *Unio*. The vernacular name is 巨蚌属 (pinyin: jù bàng shǔ).

Remarks: Due to the absence of muscle tissues for molecular phylogenetic analysis, this genus is provisionally assigned to the subfamily Unioninae and tribe Unionini based on its thick shell. The new genus can be easily distinguished from all genera of the subfamily by the large, symmetric, inflated, solid, thick, and triangular-ovate shell. It is only somewhat similar to *Pseudobaphia* Simpson, 1900, but differs by its more inflated, larger, and thicker shell.

Gigaunio sichuanensis Z.-G. Chen, Y.-T. Dai, X. Liu & X.-P. Wu, sp. nov.

https://zoobank.org/246B4A49-2606-4F19-89AD-122CC2C581E3
Figs 1–4

Type material: *Holotype.* NCUXPWU 2412001 (a pair of shell), Anxihe River [安溪河], Yangou Village [严沟村], Danling County [丹棱县], Meishan City [眉山市], Sichuan Province [四川省], China, 103°25′26″E, 29°58′24″N, leg. Yu-Chen Wang & Bo Li, ex. Zhong-Guang Chen, November 2024.

Paratypes: n=49, ZGCC B2412002–050 (left shells); n=41, ZGCC B2412051–091 (right shells), other information same as holotype; n=1, ZGCC B2412092 (right shell), leg. Xin Liu, other information same as holotype; n=2, ZGCC B2412093–094 (left shells), Nanhe River [南河], Qionglai City [邛崃市], ChengduCity [成都市], Sichuan Province [四川省], China, 103°25'16″E, 30°24'44″N, leg. Xin Liu, ex. Zhong-Guang Chen, September 2022; n=1, ZGCC B2412095 (left shell), leg. Zhong-Guang Chen, January 2021, other information same as paratypes NCUXPWU2412093–094.

Non-type specimens: n=7, IZCAS FM01681, 10556–10561, Tiexi Bridge [铁溪桥], Taiping Community [太平公社], Xinjin District [新津区], ChengduCity [成都市], Sichuan Province [四川省], China, 103°45'46.″E, 30°23'51″N, leg. Yao-Guang Wang & De-Niu Chen, det. Yue-Ying Liu, April 1964.

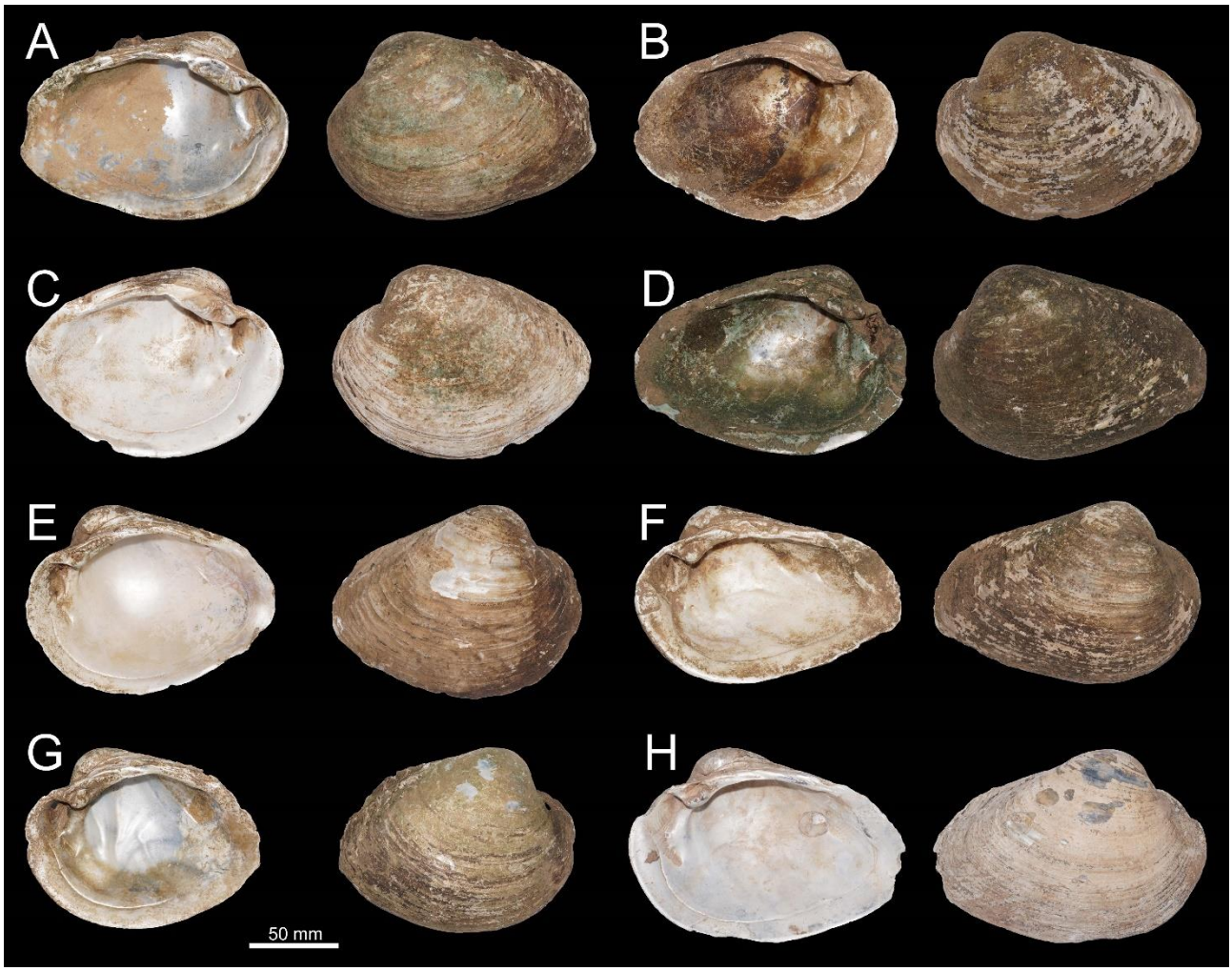

FIGURE 2. Partial adult paratypes of *Gigaunio sichuanensis* **gen. & sp. nov.**: **A–D** ZGCC B2412002–005 **E–H** ZGCC B2412051–054.

Diagnosis: Same as the genus.

Description: Same as the genus.

Measurements: Holotype (a pair of shell): shell length 147.2 mm, height 110.8 mm, width 85.2 mm. Paratypes (all are half shells, only measured the specimens with a completeness of over 90%, n=56): shell length 49.0–154.9 mm, height 38.5–125.6 mm, width 14.2–43.8 mm. Based on the fragments, the maximum length of the species may could exceeded 200 mm.

Etymology: The species is named after sichuan, the type locality. The vernacular name is 四川巨蚌 (pinyin: sì chuān jù bàng).

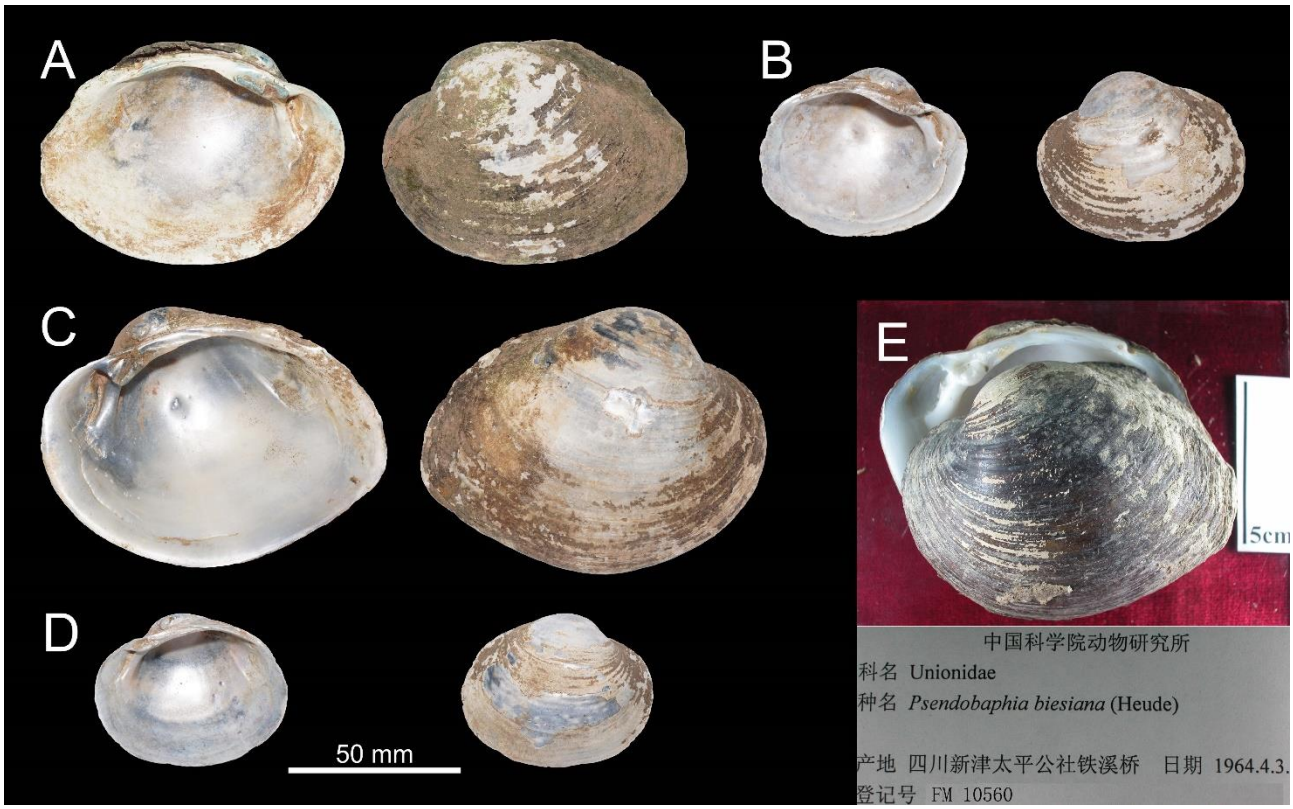

FIGURE 3. Partial juvenile paratypes of *Gigaunio sichuanensis* **gen. & sp. nov.**: **A–B** ZGCC B2412006–007 **C–D** ZGCC B2412055–056; **E** IZCAS FM10560, photoed by Kaibayer Meng.

Distribution and ecology: Known from the tributaries of the Minjiang River, including the Anxihe River, the Nanhe River and the Hanyuanhu Lake (Figs 5, 6). Living in the waters with pebble substrates alongside *Pseudocuneopsis sichuanensis* Huang, Dai, Chen & Wu, 2022, *Nodularia douglasiae* (Griffith & Pidgeon, 1833) and *Sinanodonta woodiana* (Lea, 1834) (Fig. 6).

Remarks: Seven specimens (IZCAS FM01681, 10556–10561), deposited in the Institute of Zoology, Chinese Academy of Sciences, were previously misidentified as *Pseudobaphia biesiana* (Heude, 1877). These specimens can be distinguished from *P. biesiana* by their notably more inflated, larger, and thicker shells, as well as stronger pseudocardinal teeth. Their distinct geographic distributions—separated by thousands of kilometers (Sichuan vs. Anhui)—further support their separation. A mysterious species recorded in the same region, *Acuticosta sichuanica* Zeng & Liu, 1989, resembles the juvenile of the new species. However, the new species can be distinguished from it by the more rounded shell and the weaker pseudocardinal teeth.

The new species exhibits a large and thick shell, similar to those of *Gibbosula crassa* (Wood, 1815), *Lamprotula triclava* (Heude, 1877), and the genus *Aculamprotula* Wu, Liang, Wang & Ouyang, 1999. These three taxa share a preference for rapid-flow habitats, suggesting analogous ecological adaptations in the new species. However, extensive dam construction in Sichuan in recent decades has eliminated the majority of natural rapids, a key habitat alteration that likely contributed to its extinction. The first author conducted comprehensive field surveys throughout the Minjiang River Basin for seven years but found no living individuals of the new species. Of its four known historical localities, three—located in the Nanhe and Anxihe rivers—have been transformed into slow-flowing habitats due to dam impoundment. The fourth site, the Hanyuanhu Lake, has been completely converted into a deep reservoir. Reduced flow velocity is likely one of the key factors contributing to the extinction of the new species. In addition, water pollution from human activities may have also played a role. Local residents near the Qionglai locality reported that a former upstream pig farm caused severe river pollution in the past. Supporting this, all specimens of *P. sichuanensis* collected together with the new species at this site were also empty

shells, indicating substantial environmental degradation. The last living record of the new species dates to 1964, when seven live specimens were collected during a field survey (Fig. 3E). It is urgent to raise awareness and implement effective conservation measures for freshwater mussels in the upper Changjiang River; otherwise, remaining endemic species may continue to be lost.

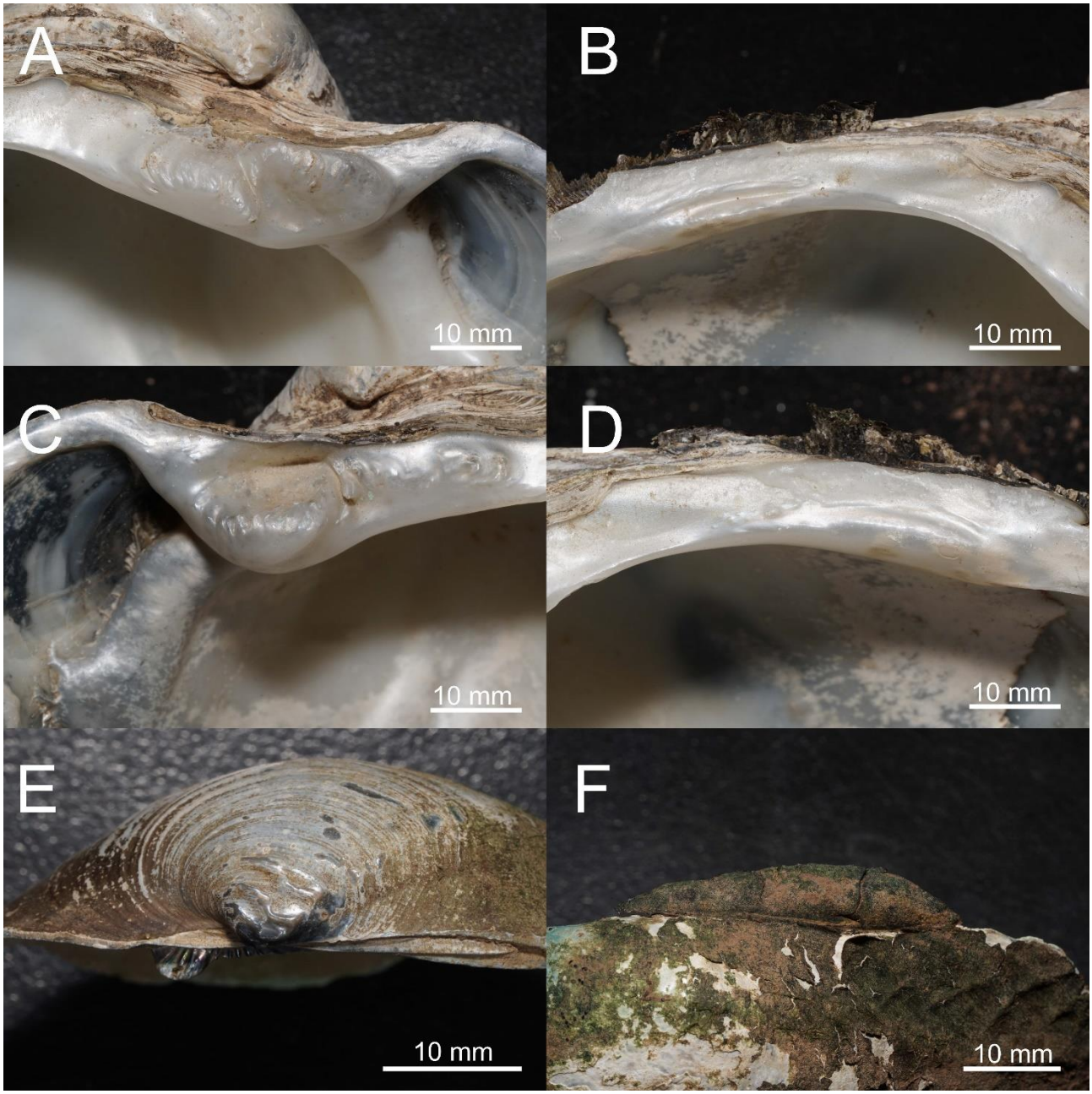

FIGURE 4. Details of the shells of *Gigaunio sichuanensis* **gen. & sp. nov.**: **A** left pseudocardinal teeth **B** left lateral teeth **C** right pseudocardinal teeth **D** right lateral teeth **E** umbo **F** hinge.

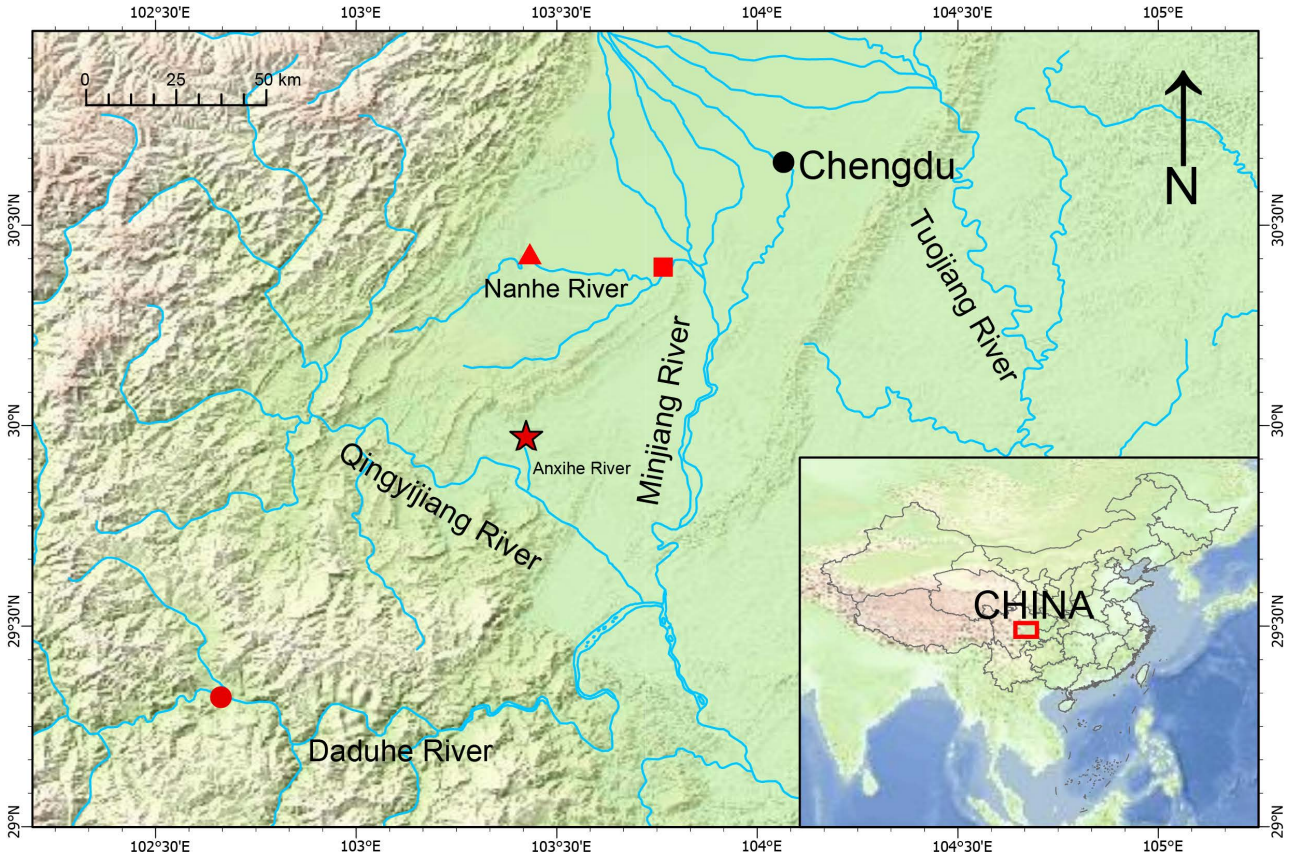

FIGURE 5. Distribution of *Gigaunio sichuanensis* **gen. & sp. nov.**: **Star** Yangou Village **triangle** Qionglai City **square** Taiping Community **Point** the Hanyuanhu Lake.

FIGURE 6. Habitat of *Gigaunio sichuanensis* **gen. & sp. nov.**: **A** the Anxihe River at Yangou Village **B** the Nanhe River at Qionglai City.

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Additional information

Author contributions: Z-G Chen designed the study. Z-G Chen & X Liu collected and examined the specimens. All authors prepared the manuscript. Z-G Chen & Y-X Ge revised the manuscript.

Conflict of interest: The authors have declared that no competing interests exist.

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